2nd Revision, July 16, 2004

Determinants of subcontracting and regional development
An empirical study on Turkish textile and engineering industries

Erol Taymaz - Yılmaz Kılıçaslan
Department of Economics
Middle East Technical University
Ankara 06531 Turkey

Abstract
Recent studies on small and medium sized establishments emphasize the importance of networking and regional clusters for (regional) industrial development. This study is focused on an important form of cooperation between firms: subcontracting relationship. Our aim is to identify the determinants of subcontracting in Turkish textile and engineering industries, and to derive policy implications of our empirical analysis. We estimate subcontract offering and subcontract receiving models for both industries by using panel data on all establishments employing 10 or more workers in the period 1993-2000. Our findings show that short-term/unequal relationship exists between clients and subcontractors in the textile industry whereas subcontracting relationships in the engineering industry are established between "similar", relatively advanced firms that have complementary assets and technologies. Moreover, subcontracting flourishes in regions densely populated by firms.

Keywords: Subcontracting, networks, industrial development, regional development

JEL Codes: R11, R12, L24, L6

Acknowledgements. The authors thank Cem Somel of METU and three anonymous referees of this journal for their very helpful comments on the earlier versions of the paper.

Corresponding author: Erol Taymaz, Department of Economics, Middle East Technical University, Ankara 06531, Turkey
e-mail: etaymaz@metu.edu.tr, Phone: +90 312 210 3034, Fax: +90 312 210 1244

1. Introduction

In most of the twentieth century, small and medium-sized establishments (SMEs) were considered to be an archetypical and declining sector in which "informal" and "pre-modern" labor relations and technologies hindered the process of economic development. In this context, “subcontracting” was considered as a form of domination of large firms over small ones where large firms benefited from low wages and flexible work arrangements in small firms. The SME sector was thought to be eliminated by more efficient and advanced large firms. The tendency towards gigantism was dominant among public policy makers both in the developed and the less developed countries (LDCs) who were trying to imitate the industrial development experience of the former group since the early 20th century. The apparent failure of the industrialization attempt in most of the LDCs, the prolonged economic crisis in the developed countries in the 1970s and 1980s, and the striking resistance and vitality of SMEs in developing as well as in developed countries forced policy makers to re-evaluate their role in the economy.

The small firm has increasingly become the focus for public policy designed to decrease unemployment in the developed and less developed countries. In the 1970s and 1980s, international organizations, like the World Bank and the United Nations Industrial Development Organization (UNIDO), started to advocate the promotion of SMEs to alleviate the problems of unemployment in the LDCs. It was argued that the capital-intensive "modern" sector in the LDCs was unable to generate sufficient employment opportunities for a rapidly growing population. Subcontracting was supposed to play an important role in policies designed to promote SMEs. The Turkish governments also adopted SME-promotion policies under the influence of international organizations in the same period.

Almost all policy documents in Turkey emphasize the importance of SMEs for industrialization and regional development, and call for various support programs for those establishments. In spite of this rhetoric, there are not many comprehensive empirical studies on SMEs and the extent and causes of subcontracting relations. To the best of our knowledge, this is the first study that analyzes the determinants of subcontracting at the firm level covering major manufacturing sectors in Turkey. The study is restricted to textile and engineering (metalworking) industries because subcontracting relations are developed mainly in these two sectors. Moreover, these industries account almost 60 percent of manufacturing employment. Our aim is to identify types of subcontracting relationships, and characteristics of firms that enter into subcontracting relationships. Two models, one for the share of subcontracted inputs (subcontract offering firms), and the other for the share of subcontracted output (subcontract receiving firms), are estimated by using the data for all establishments employing 10 or more people in the period of 1993-2000. The estimated model is the random-effects Tobit model.

The paper is organized as follows. Section 2 summarizes various approaches on subcontracting. Section 3 presents a descriptive analysis on the extent of subcontracting in Turkish manufacturing industries. Section 4 develops the model and presents the estimation results. Section 5 summarizes policy implications.

2. Economic development, regional networking and subcontracting

Subcontracting is usually defined as a form of relationship between firms mostly depending upon complete or partial production of goods and services. A more formal definition of subcontracting would be “a situation where the firm offering the subcontract requests another independent enterprise to undertake the production or carry out the processing of a

material, component, part or subassembly for it according to specifications or plans provided by the firm offering the subcontract" (Holmes, 1986: 84). In other words, subcontracting is a specific form of outsourcing that involves intimate relations and information exchange between firms (Heshmati, 2003).

Why do firms establish subcontracting relationships? There are three different theoretical approaches in analyzing subcontracting (Table 1; for detailed analyses, see Arena, Ravix and Romani, 1992; Clarke, 1994). The first approach considers subcontracting as an unequal power relationship. This approach is based on the concept of the "dualistic economy" which comprises two segmented sets of enterprises, the large (multinational) corporations, and small firms (Berger and Piore, 1980). Subcontracting is seen as a relationship in which large contactors benefit at the expense of small subcontractors (for a comprehensive analysis along these lines, see Taylor and Thrift, 1982). The "subservient role of the small firm" is characterized by i) its small size and the resource base it commands, ii) its weak bargaining position and the dependence on the will of the large firms, and iii) its subordination to conditions and specifications dictated by the contactors (Imrie, 1986). In other words, a typical subcontractor is a technologically backward, small firm.

There are two main reasons why a large firm prefers to outsource a part of its production process to subcontractors. One of the main benefits accruing to a large firm from subcontracting is the advantage of flexibility (Holmes, 1986). As exemplified in the case of capacity subcontracting (Watanabe, 1971), large firms mitigate fluctuations in demand by contracting out the unstable part to small firms. Second main benefit of subcontracting for large firms is related with cost reduction. The large firm may seek to subcontract a part of its (unskilled labor-intensive) production operations to take advantage

of lower wages in small firms. This case arises when there is a kind of “dual labor market” and the subcontractor firm does not have the capability to distribute and to market its own products. In this case, large firms benefit from lower wages paid by small firms who employ mostly unorganized labor working in poor conditions without proper employment security. Subcontracting can also be used by large firms to cut the fixed costs, because they can spread out their costs through subcontracting.

The second approach, formulated mainly by development economists, also considers subcontracting as a relationship between large and small firms, but assigns a positive role to it: subcontracting is regarded as a tool for modernization and employment generation. For example, Watanabe (1971: 51), in one of the leading articles on subcontracting, claimed that "... subcontracting can smooth the path of small enterprises and make them a suitable instrument for mass employment creation in developing countries that are committed to industrialisation." In a similar manner, UNIDO also called for the promotion of industrial subcontracting (for example, see UNIDO, 1974). The main idea behind advocating the development of subcontracting is based on the benefits a small subcontractor derives from a large firm in the form of guaranteed markets, secured raw materials, and technical assistance. Large firms that adopt modern technology would diffuse modern production techniques (the control of production processes, quality control, so forth) to subcontractors. Large firms outsource their activities to small firms not as a search for low wages, but to improve their competitiveness through focusing on core competencies, accessing to world-class capabilities, sharing risks, etc. (Deavers, 1997).

Watanabe (1971: 73) even suggested that if “the small size of local markets and the scarcity or non-existence of potential parent firms with adequate marketing capacity and technological know-how” creates a problem, it can be solved by “casting established

foreign companies in the role of parent firm" (on the role of international subcontracting, see Bose, 1990; Kumar, 1996; Crone, 2002). As Potter, Moore and Spires (2003) have shown foreign investment can be beneficial for domestic suppliers even in developed countries like the UK.

This argument on the role of large firms is based on the old dichotomy between modern/large firms and traditional/small firms. Based on this argument, one can claim that export oriented international subcontracting may favor economic development by expanding manufactured exports for developing countries. In addition to this direct effect, international subcontracting of production may result in transfer of knowledge, designs, specifications and quality controls to the LDCs.

An Expert Committee Report prepared for the Sixth 5 Year Development Plan in Turkey echoes the same argument (State Planning Organization, 1989: 148-149). It is claimed in the report that modern industry integrates firms in such a way that large industrial enterprises form the governing and leading main sector whereas small enterprises form the secondary/auxiliary sector. In this context, subcontracting is expected to lead to efficiency gains for large enterprises. The policy measures for encouraging subcontracting are similar to those suggested by the World Bank in 1980: "reduced import duties on machinery for subcontractors, accelerated depreciation allowance on equipment to facilitate subcontractors' acquisition of capital assets, provision of industrial extension services, materials testing equipment and industrial estate facilities" (World Bank, 1980, v.3: 46-47, cited in Kaytaz, 1994: 152).

There has been a shift in the locus of studies and policy proposals in recent years, especially after the publication of the influential book by Piore and Sabel (1984) on flexible specialization. The emphasis is now on networking and clusters, usually formed by SMEs

themselves. International organizations like UNIDO (Ceglie and Dini, 1999), ILO (Pyke, 1992) and UNCTAD (UNCTAD, 1994) now support networking initiatives and the development of industrial districts. It is suggested that "on the account of the common problems they all share, small enterprises are in the best position to help each other" (Ceglie and Dini, 1999). They can do so through horizontal cooperation (they can collectively achieve scale economies), vertical cooperation (they can specialize in their core activities and develop the external division of labor), and networking among enterprises, providers of business development services, and local policy makers. These studies show that the dichotomy between large/client firm and small/subcontractor[1] firm is not valid, and non-market mediated interactions between firms should also be taken into account in designing and implementing economic policies.

Spatial clustering is an important factor for establishing subcontracting relationships because, as Rama and Calatrava (2002) have shown in the context of Spanish electronics industry, "clustering accrues significant benefits to subcontractors, especially small or regional firms". Moreover, patterns of subcontracting, as a specific form of networking, are associated with specific types of industrial districts (Rama, Ferguson and Melero, 2003). This literature emphasizes the importance of knowledge transfers through subcontracting relations (for two cases, see Chew and Yeung, 2001; Deardorff and Djankov, 2000).

As our brief presentation indicates, there are significant differences between traditional and new approaches to subcontracting. Traditional approaches consider subcontracting as a relationship between two firms, the large client and the small subcontractor. The unit of analysis is a specific subcontracting relationship between two

[1] Throughout this paper, we use the term "client" (for "contractor") to refer to firms that grant subcontracts.

particular firms. New approaches like the network and cluster approaches, as their names imply, look at a group of firms cooperating (and competing) within a complex web of supportive institutions. Externalities generated by this form of cooperation and competition are internalized by the network so that the collective efficiency and flexibility is enhanced. Moreover, the subcontractor in the traditional approach is a passive, dependent firm: it is dependent on the large firm, and may benefit from subcontracting (in the form of guaranteed markets, technical assistance, so forth) to the extent the client firm allows. However, the dichotomy between the large client and the small subcontractor does not exist in the network analysis because the network can be established even only by small firms. Indeed, one of the main requirements for a well-functioning network is the fact that all firms in the network should have a certain level of technological capability to interact with each other.

We consider all these conceptualizations not as alternatives, but formalizations of different types of inter-firm relationships corresponding to different models of development. In the case of dualistic approaches, subcontracting arises as an unequal power relationship between technologically advanced large firms employing skilled labor and technologically backward small firms employing un-skilled and unorganized labor. Subcontracting relationship in this case reinforces the segmented nature of the economy. In the developmental approach, the same dichotomy is valid, but the small firm also benefits from subcontracting in the form of secured markets, technology transfer, etc. Thus, subcontracting can be used as a tool to assist small firms. In the case of the cluster approach, subcontracting itself is one of the main types of networking on which clusters could be established. Subcontracting is established between equals: subcontractors receive

---

The term “two-way contractors” (also referred to as “primary contractors”) is used for those firms that both

offers thanks to their technological capabilities and complementarities. In the rest of the paper, we will investigate which model seems to be valid in Turkish textile[2] and engineering industries.

3. Subcontracting in Turkish manufacturing industries

Although there are some survey and field studies that analyzed subcontracting relationships in Turkish manufacturing industries (for a small sample, see Bademli, 1977; Ayata, 1991; Aktar, 1990; Evcimen, Kaytaz and Cinar, 1991; Kaytaz, 1994; and Ozcan, 1995), there is almost no comprehensive study in this field. Altin's study (1995) is one of the first studies that analyze firm characteristics and subcontracting for all sectors of the manufacturing industry.

The data used in our study come from the Annual Surveys of Manufacturing Industry. These Surveys cover all establishments[3] in the manufacturing industry employing at least 10 workers, i.e., it covers both large and small firms.[4] The survey uses the Turkish word *"fason"*, and defines "income from subcontract" as "income generated from the processing of materials provided by the firm offering the subcontract".

Table 2 presents the data on subcontracting intensity in Turkish manufacturing industries at the 2-digit ISIC level for the period 1993-2000. The table includes the data on sectors' share in manufacturing employment in 2000 as an indicator of relative size. Both unweighted and weighted (by value of output/input) averages are presented in the table

---

grant and receive subcontracts.

[2] "Textile industry" refers to the textile and clothing industry (ISIC 32, Rev. 2). ISIC refers to the International Standard Industrial Classification, Revision 2.

[3] Since most of the firms in the Turkish manufacturing industry are single-plant firms, we use the concepts of "firm", "establishment" and "enterprise" interchangeably.

[4] The questions on subcontracting have been added to the questionnaire for the size group 10-24 since 1993. Since we prefer to cover small firms in our empirical analysis, we could not use the data before 1993. There are no comparable data for micro-establishments (employing 1-9 people).

because the unweighted averages indicate the importance of subcontracting for firms operating in the relevant sector, whereas weighted values measure the extent of subcontracting at the sectoral level.

Subcontracting intensity (as measured by the share of subcontracted output in total output, and the share of subcontracted inputs in all inputs) is rather low in the Turkish manufacturing industry (about 2-4 %). There are significant inter-industry variations in subcontracting intensity. The textile industry has the highest subcontracted output and input shares (7.5% of output and 17.1% of inputs, unweighted values), followed by the paper, engineering, and "other manufacturing" industries. In this study, we analyze the determinants of subcontracting only in the textile and engineering industries because of their subcontracting intensity and dominant positions within the manufacturing industry (these two industries alone accounted for almost 60 percent of manufacturing employment in 2000).

The second part of the table shows subcontracting intensity for a selected sub-group of sub-sectors. Textile products and wearing apparel have very high share of subcontracted output and input intensities, followed by spinning, weaving and finishing, knitting mills, fur and leather products, and tanneries and leather finishing. In the engineering industry, the most subcontracting intensive sub-sectors are engines and turbines, ship building and repairing, structural metal products, other fabricated metal products, and professional and scientific equipment.[5]

It is interesting to observe that subcontracted input-intensive sectors tend to be also subcontracted output-intensive, but there are meaningful differences as well. For example, subcontracted output share is higher than input share in spinning, weaving and finishing,

but it is the other way around in the case of textile products and wearing apparel. It is likely that a large number of firms in spinning, weaving and finishing operate as subcontractors for firms in other sectors that produce final goods (like textile products and wearing apparel).

The distribution of textile and engineering firms in Turkey is shown in Figures 1a and 1b, respectively. All provinces are grouped into five categories in terms of their share in the average number of firms operating in the period 1993-2000. As shown in Figure 1a, textile firms are concentrated in a few regions/provinces. It is possible to identify three clusters, around Istanbul (Istanbul, Bursa and Tekirdag), Izmir (Izmir, Denizli, Manisa and Usak), and Adana (Adana and Gaziantep). About 75 % of textile firms are located in only four provinces (Istanbul, Izmir, Bursa and Denizli). Engineering firms are distributed somewhat uniformly around the country: we observe concentration of engineering firms along the Istanbul-Ankara-Adana axis cutting across the country, and in the western regions (Izmir and the surrounding provinces). Four main provinces, Istanbul, Izmir, Bursa and Ankara, account for almost 60% of engineering firms in Turkey.

Figures 1c and 1d depict the provinces' share in subcontracting transactions conducted in the period 1993-2000. [6] There is a strong correlation between the regional distribution of firms and subcontracting activities but subcontracting activities seem to be more concentrated than the distribution of firms. Those provinces that account for a large share of firms account for even larger share of subcontracting transactions.[7]

---

[5] As a referee mentioned, subcontracting can take place between large firms, especially in major engineering projects. Very high share of subcontracted inputs in the "ship building and repair" sector could be an example for this kind of subcontracting.

[6] "Subcontracting transactions" are defined as total value of subcontracted outputs and inputs in 1994 prices (1993-2000 averages).

[7] The correlation between the (log) number of firms and subcontracting transactions (1993-2000 averages) at the province level is statistically significant at the 1% level for both industries. The slope coefficient estimated by regressing (log) value of subcontracting on (log) number of firms is greater than one. This finding shows that subcontracting *intensity* increases by the number of firms at the province level.

Table 3 presents the data about the characteristics of firms according to their subcontracting behavior. Firms in the first column are not involved in any subcontracting relationship. Subcontractor and client firms are in the second and third columns, respectively. Firms in the fourth column both receive subcontract orders and offer subcontracts to other subcontractors (for convenience, we call these firms "two-way contractors"). The data show that there are substantial numbers of firms that simultaneously receive and offer subcontracts. This indicates that secondary subcontracting is a widespread phenomenon in Turkish textile and engineering industries.

Subcontracted input share is about 13-16% for clients and two-way contractors in the textile industry and 8-10% in the engineering industry. Although subcontracted input shares are relatively low, i.e., clients are not heavily dependent on subcontractors, subcontracted output share for subcontractors is quite high in the textile industry (more than 50 percent), and sizeable in the engineering industry (about 22 %).

Subcontracting relations are widespread in the textile industry in terms of the number of participating firms. Only 30% of textile firms are not involved in any form of subcontracting, whereas the shares of subcontractors, clients, and two-way contractors are 20, 25, and 27%, respectively. Engineering firms have rather a different attitude towards subcontracting: a much higher proportion of engineering firms (43%) are not involved in any form of subcontracting, and the share of subcontractors is very low: only 5%. However, half of engineering firms who participate in subcontracting relations are two-way contractors, and the rest are clients.

The average firm size shows a similar pattern in the textile and engineering industries. In both sectors, two-way contractors and clients are, on average, larger than others (in terms of the number of employees), and the size differential is wider in the textile

industry. In spite of size differentials, average wage rates do not differ very much across subcontracting categories in the textile industry. Clients and two-way contractors pay wages only 10-15% higher than other firms. The wage differential seems to be wider in the engineering industry where clients pay 33% higher than those that are not involved in any subcontracting relationship. It is interesting to observe that two-way contractors pay on average the highest wage in the engineering industry. Although subcontractors pay the lowest wages in the textile industry, subcontractors in the engineering industry pay 20% more than those that are not involved in any subcontracting relationship. There are significant inter-industry wage differentials as well. Average wage rate is 42 % higher in the engineering industry than in the textile industry.

The share of female workers is higher in textile firms participating in subcontracting relations and almost the same for all categories in the engineering industry. The share of administrative personnel is lower in subcontractor textile firms, whereas subcontractors, clients, and two-way contractors in the engineering industry employ proportionately more administrative personnel that the rest of the firms. The share of skilled employees seems to be the same across all categories of firms.

Technological characteristics seem to matter for subcontracting. In both industries, clients and two-way contractors use more capital intensive technologies than subcontractors. In the textile industry, the lowest capital intensity is observed in the case of subcontractors. However, subcontractors in the engineering industry are different in the sense that their technologies are more capital intensive than those firms that do not participate in subcontracting. In both industries, clients and two-way subcontractors achieve higher rates of growth (in real output), and clients tend to avoid working in second

and third shifts. There are no significant differences between subcontracting categories in terms of communication and advertisement intensities,

Finally, as observed in Figure 1, subcontracting flourishes in provinces densely populated by firms operating in the same industry. The number of firms operating in the same sector and province is much higher for subcontractors, and especially for clients and two-way contractors than those not participating in any type of subcontracting relation.

4. Determinants of subcontracting in Turkish textile and engineering industries

Following the literature on subcontracting, we assume that the decision to offer and to receive a subcontract depends on a number of variables that reflects sectoral and firm-specific characteristics (for a study on construction industry, see Gonzalez, Arrunada and Fernandez, 2000). We estimate two models, one for the share of subcontracted inputs (subcontract offering firms), and the other for subcontracted output (subcontract receiving firms) by using plant level data for the period 1993-2000. The estimated model is the random-effects Tobit model which can be written as

$$y_{it} = \begin{cases} 1 & if \quad y_{it}^{*} \geq 1 \\ y_{it}^{*} & if \quad 1 > y_{it}^{*} > 0 \\ 0 & if \quad y_{it}^{*} \leq 0 \end{cases}$$

and

$$y_{it}^{*} = \beta_{0i} + \sum_{k \in K} \beta_{kit} x_{kit} + \varepsilon_{it}$$

where y_{it} is the (observed) share of subcontracted input (output) for the i^{th} establishment at time t, y^{*}_{it} the latent (index) variable that reflects the propensity to subcontract, x_{kit} the k^{th} explanatory variable, and ε_{it} the error term. Moreover, β_{oi} are assumed to be independently

and identically distributed (i.i.d.) with zero mean and σ_u. This term is used to control for unobservable firm-specific factors. The share of subcontracted inputs for subcontract offering firms is denoted by *Sub-Input,* and the share of subcontracted output for subcontract receiving firms by *Sub-Output*.

The dualistic economy and developmental subcontracting approaches suggest that the firm size and wage differentials are among the main determinants of subcontracting relationship. There is also some econometric evidence (Kelley and Harrison, 1993; Christerson and Appelbaum, 1995; Kimura, 2002) that shows that large firms are more likely to offer subcontracting to small firms. We use the (log) level of employment, SIZE, to test this hypothesis. If it is correct, the coefficient of the SIZE variable is expected to be positive (negative) in the subcontract offering (receiving) model. The WAGE variable, defined by the (log) average annual wage rate per employee, is used to test if high-wage firms subcontract a larger part of their production to firms that pay lower wages. If the hypothesis is correct, we expect a positive coefficient for the WAGE variable in the subcontract offering model, and a negative coefficient in the subcontract receiving model. However, if the subcontracting relationship is established between "similar" firms, as suggested by the cluster approach, then neither the SIZE nor the WAGE variables may have any impact on subcontracting behavior.

It is suggested by the dualistic economy approach that subcontracting could be used as an instrument in reducing large firms' costs through "production smoothing" (Berger and Piore, 1980; Holmes, 1986). In this case, which is also defined as "capacity subcontracting", large firms use (small) subcontractors as a pool of capacity, and outsource when they reach to the limits of their production capacity. There are two variables used to

test if capacity subcontracting exists in textile and engineering industries, OVER23, and GRFIRM.

OVER23 is defined as the share of number of hours worked in the second and third shifts in total number of hours worked. This variable may have both a temporary and a permanent impact on subcontracting behaviour. If a firm experiences a rapid growth in the demand for its products, firstly, it may increase the number of hours worked by employing workers for the second and even for the third shift. If it cannot satisfy the demand by increasing the number of hours worked, then it may decide to subcontract a part of its production to others (the case of capacity subcontracting). Therefore, we may expect a positive impact of the OVER23 variable on the share of subcontracted inputs. This is a temporary effect because the firm may expand its capacity in investing in fixed capital in the long run. If the subcontractor receives contracts for processes that require high fixed costs (as in the case of specialization subcontracting) the subcontractor may economize on capital costs by using its machinery and equipment more intensely, i.e., by employing workers for the second and third shifts. This is the permanent impact on subcontractors: in this case, we expect a positive effect of the OVER23 variable on the share of subcontracted output intensity. The annual output growth rate of the firm (GRFIRM) is also used to capture the effects of capacity limits on subcontracting behavior. It is expected to have a positive impact on subcontracting inputs.

New theories on subcontracting emphasize the importance of networks and clusters in forming subcontracting relationship between firms that own complementary assets. Unfortunately, there is no information available on the content and form of the subcontracting in our database. Therefore, we draw on variables related with firms'

technological characteristics and the composition of their labor force to draw conclusions on the form of networking and clustering.

The (log) number of firms operating in the same sector and in the same province, NFIRM, is used to test the effects of regional clusters on subcontracting behavior. A higher value for the NFIRM variable will indicate regional concentration of establishments. If there is only one firm in the same province and the sector where the firm operates, the value of NFIRM will be equal to zero. The literature emphasizes the benefit accruing to clients and subcontractors through spatial clustering, especially in high technology industries (see, for example, Rama and Calatrava, 2002). Thus, a positive coefficient for the NFIRM variable is expected in both subcontract offering and receiving models.

Firms that produce differentiated products may have higher communications intensity because they need to exchange information intensively with suppliers and customers. Product differentiation, on the other hand, increases the scope for subcontracting. Therefore, we expect a positive relationship between subcontracting intensity and communications intensity, defined for empirical purposes by the proportion of expenditures on communications services to total sales revenue (PTT) (for a similar argument on the effects of product diversity on outsourcing, see Kelley and Harrison, 1990).

The advertising intensity of the firm (ADVER, the share of advertisement expenditure in total sales revenue) is added into our models to test if final goods producers, that have higher advertisement intensity, tend to outsource their manufacturing activities. We expect a positive impact of the ADVER variable on subcontracted input intensity (final producers can subcontract a broad range of activities), but no impact on subcontracted output intensity.

The CAPINT variable is defined by (log) annual depreciation allowances per employee, and it measures capital intensity of the production process. This variable may reveal the relationship between production technology and subcontracting behavior. We expect that capital-intensive firms will have higher outsourcing intensity.

There are three variables used to control the effects of the composition of the labor force on subcontracting behavior: FEMALE, ADMIN, and SKILLED. These variables are defined by the shares of female, administrative, and skilled (engineers, technicians, and managers) personnel in all employees, respectively. Ypeij (1998) suggests that subcontracting is not a gender-neutral process: "feminized" production tasks are frequently subcontracted to the small-scale producers because i) female workers are paid lower wages, ii) "feminized" tasks are labor-intensive, and iii) women already possess knowledge that can be transferred into skills for labor-intensive, "feminized" tasks. As a result, we expect a negative coefficient for the FEMALE variable in the subcontract offering model, and a positive coefficient in the subcontract receiving model.

The share of administrative personnel may also have an impact on subcontracting behavior: Those firms that employ proportionately more administrative personnel can specialize in non-production activities (design, distribution, marketing) subcontracting out a large part of the production process. A subcontractor, however, is specialized in production activities, and will employ more production workers.

The share of skilled personnel may have a similar effect. If subcontractors receive orders for their specialized activities that require skilled labor, the SKILLED variables will have a positive coefficient in the subcontract receiving model. On the other hand, if the subcontractors have a competitive advantage thanks to their low skilled-low wage labor, than we expect a negative coefficient.

Finally, the TIME variable is used in the models to check if there is an exogenous shift in subcontracting intensity that cannot be explained by other factors.

Estimation results are presented in Table 4.[8] There is a striking pattern of similarities and differences between the textile and engineering industries. First of all, geographical concentration, that is, the existence of local clusters, seems to be very important in establishing subcontracting relations. The NFIRM variable has a positive coefficient for both subcontract receiving and offering models in the textile and engineering industries.[9] This is one of the strongest results of our analysis, and it has significant policy implications.

The growth rate of the firm (GRFIRM) has a positive impact on subcontract offering in both sectors (but not significant in the textile industry) and negative impact on subcontract receiving (but not significant in the engineering industry). This finding indicates that a rapidly growing firm is likely to subcontract a part of the production process out, i.e., capacity subcontracting is observed in both sectors. The capital intensity variable (CAPINT) has positive coefficients in the subcontract offering models, and a negative coefficient in the subcontract receiving model for the textile industry. This shows that capital-intensive firms are more likely to offer subcontracts, and labor-intensive firms in the textile industry, tend to operate as subcontractors, as a result of risk-sharing behavior of capital-intensive firms (for risk sharing, see Yun, 1999; Okamuro, 2001). However, contrary to the case of textile firms, subcontractors in the engineering industry do not use labor-intensive technologies. This may partially reflect the importance of specialization (supplier) subcontracting in this industry.

[8] Estimated coefficients in the Tobit model can be used to determine both changes in the probability of establishing a subcontracting relationship and changes in the share of subcontracted input/output if the firm is already involved in subcontracting. In our interpretations, we consider effects at the sectoral level and do not quantify this decomposition.

The estimation results for the OVER23 variable provide complementary evidence on the characteristics of subcontract offering and receiving firms. The OVER23 variable has a positive effect on subcontract receiving and negative effect on subcontract offering in the textile industry. The positive effect on subcontracted output indicates that subcontractors tend to economize especially on capital costs by working longer, and clients tend to avoid high labor costs of second and third shifts. However, working conditions do not have any significant impact on subcontracting behavior in the engineering industry.

The advertisement intensity has a positive effect on subcontracted input intensity in the engineering industry. It seems that those engineering firms that produce final products tend to subcontract a larger part of their production activities. The PTT variable has a positive coefficient only in the subcontract receiving model for the textile industry.

Labor-related variables reveal sharp differences between these two industries. First of all, establishment size indicates a major difference between the textile and engineering industries. It has the effects suggested by the traditional approaches in the textile industry: positive effect on subcontract offering and negative effect on subcontract receiving. Large firms tend to subcontract a larger part of their production, and small firms to receive more subcontract orders in the textile industry. However, the size variable has positive coefficient for both subcontract offering and receiving models for the engineering industry, although the second one is not statistically significant.

The wage rate has also a similar effect on subcontracting in the textile industry. High wage textile firms tend to subcontract a bigger part of their production, and low wage textile firms have an advantage over others in receiving subcontract orders in the textile industry, but after controlling for all other factors, these effects are not statistically

[9] Unless otherwise stated, all effects are statistically significant at the 5% level, two-tailed test.

significant. However, the WAGE variable has a positive effect on subcontracting, both in the subcontract receiving and offering models for the engineering industry. High wage engineering firms have a higher subcontracted input and output shares. This finding supports Kaytaz's (1994) and Watanabe's (1971) observation that subcontracts are more specialization oriented in the engineering industry.

The estimates for the FEMALE variable partly reinforce the findings on the WAGE variable. Contrary to what Ypeij (1998) observed in Peru, the share of female employees has a positive impact on subcontract offering firms in the textile industry. In other words, those textile firms that employ proportionately more female employees tend to subcontract a larger part of their production activities. However, the FEMALE variable has also a positive effect on subcontract output intensity. It seems that subcontracting relationship is established between firms that perform "feminized" activities in the textile industry. In the case of engineering industries, the FEMALE variable has a significant effect (at the 5% level) on subcontract offering, but no effect at all on subcontractors. In other words, subcontractors in the engineering industry do not perform relatively more "feminized" activities. Note, however, that the share of female employees is very low in the engineering industry (about 10 %), and most of the female personnel are employed in non-production activities.

The SKILLED variable has negative coefficient in subcontract receiving models, i.e., those firms that employ proportionately less skilled workers tend to be subcontractors. Those engineering firms that have a higher proportion of skilled personnel (engineers, technicians, and managers) tend to subcontract a large part of their production.

In the textile industry (as in the engineering industry), those firms that employ proportionately more administrative personnel tend to have a higher rate of subcontracted

input. On the other hand, subcontractors tend to have a lower share of administrative personnel in the textile industry.

Finally, the TIME variable has a negative impact both in the subcontract receiving and offering models for both sectors (but not statistically significant for subcontract receiving in the textile industry). In other words, after controlling the effects of all other variables in these models, subcontracted input and output intensities tend to decline in the period under investigation (1993-2000).[10]

We can summarize our findings as follows:

1) Traditional subcontracting relation that is simplified as a relationship between high wage/large firms employing male workers and low wage/small firms employing female workers is not dominant in Turkish textile and engineering industries. In the case of the textile industry, large wage firms tend to play the role of the client, and small firms the role of subcontractor, but wage and gender differences do not seem to be important in explaining subcontracting behaviour. In the engineering industry, neither size nor low wage nor gender is an important factor for subcontractors. On the contrary, subcontractors as well as clients tend to pay higher wages although, on average, clients in the engineering industry tend to be larger in terms of the number of employed.

2) Our findings indicate that short term capacity subcontracting exists in Turkish manufacturing industries. Long-term, specialization (and supplier) subcontracting seems to be quite important in the engineering industry. There are significant differences in terms of the determinants of subcontracting between the textile and engineering industries.

3) Location is very important in establishing subcontracting relations. Subcontracting flourishes where many firms are located in the same region. This finding

indicates that subcontracting could play an essential role in regional networking and development.

5. Conclusions

Our analysis provides evidence that "alternative" theories of subcontracting are indeed valid in different industrial contexts. Subcontracting, as a specific form of cooperation between firms, should not necessarily be conceived as an unequal relationship between small and large firms in all sectors. There are significant differences between sectors. Subcontracting relations in the textile industry resemble unequal power relations as portrayed by the dualistic economy approach whereas engineering firms establish subcontracting relations with technologically advanced firms as suggested in the network approach.

Economic policies that aim at using subcontracting to help SMEs or to promote regional development should take into consideration the fact that subcontracting is a multifaceted phenomenon that can acquire various forms under different conditions. For example, subcontracting relationships could be established between large client firms and small subcontractor firms, as in the case of Turkish textile industry. However, this type of subcontracting does not necessarily have a developmental nature because (large) clients tend to transfer the burden of risks and costs on their subcontractors. There are some field studies that document quite primitive work conditions in subcontractors in the textile industry (for example, see Aktar, 1990). However, work conditions may not be better in clients as well, partly because of the existence of a large pool of subcontractors and the flexibility of the labor market. Most of the large firms in the textile industry in Turkey

[10] Unobservable firm-specific factors are also important in explaining the subcontracting behaviour. The

seem to be far from representing the "modern" sector of the economy. Therefore, policy formulations based on the so-called modernizing role of large firms (see, for example, SPO, 1989) are not likely to be useful in helping SMEs under prevailing conditions in the textile industry. On the other hand, subcontracting in the engineering industry seems to have rather different features. Most importantly, working conditions (wages and overtime work) do not differ between clients and subcontractors in the engineering industry. In this sense, it represents a relationship between "equals" and, therefore, its development may enhance collective efficiency and flexibility.

Subcontracting can be effectively developed if there is sufficient regional concentration of firms. There may be a tension between regional development and industrial development objectives, at least in the short run. If the geographical dispersion of small firms is encouraged for regional development objectives, they may not sufficiently benefit from agglomeration and network externalities.[11] Therefore, economic policies should give a special emphasis on (regional) clustering of firms, if subcontracting relationships are expected to play a role in regional development.

References

Aktar, A. 1990. *Kapitalizm, Az Gelismislik ve Turkiye'de Kucuk Sanayi*, Istanbul: Afa Yayinlari.

Altin, S. 1995. *Turk Imalat Sanayinde Fason Imalat Sanayinin Konumu, Sektorel dagilimi ve Fason Olmayan Isyerlerinden Farkliliklari*, unpublished thesis, Ankara: State Institute of Statistics.

Arena, R., J. T. Ravix and P. Romani. 1992. "Firm Cooperation and Subcontracting", *Metroeconomica*, 43(1-2), 247-66.

Wald test for the hypothesis $\sigma_u=0$ is strongly rejected for all models (see Table 4).

[11] Geographical concentration is not, of course, sufficient to create networks of "equals" because it can also facilitate conventional subcontracting based on unequal power relations. Therefore, networking policies should be supported by various technology and training policies that enhance technological capabilities of small firms.

Ayata, S. 1991. *Sermaye Birikimi ve Toplumsal Degisim*, Ankara: Gundogan Yayinlari.

Bademli, R.R. 1977. *Distorted and Lower Forms of Capitalist Industrial Production in Underdeveloped Countries: Contemporary Artisan Shops and Workshops in Eskisehir and Gaziantep, Turkey*, unpublished Ph.D Thesis, MIT.

Berger, S. and Piore, M.J. 1980. *Dualism and Discontinuity in Industrial Societies*, Cambridge: Cambridge University Press.

Bose, A. J. C. 1990. "International Subcontracting in Automotive and Electronic Industries--Retrospect and Prospect", *Indian Economic Journal*, 38 (2), 20-32.

Ceglie, G. and M. Dini. 1999. *SME Cluster and Networking Development in Developing Countries: The Experience of UNIDO*, Working Paper No.2, Private Sector Development Branch, UNIDO, Vienna.

Chew, Y, and H. W. Yeung. 2001. "The SME Advantage: Adding Local Touch to Foreign Transnational Corporations in Singapore", *Regional Studies*, 35 (5): 431-448.

Christerson, B. and R. P. Appelbaum. 1995. "Global and Local Subcontracting: Space, Ethnicity, and the Organization of Apparel Production", *World Development*, 23 (8), 1363-1374.

Clarke, A.E. 1994. "Spatial Linkages and Subcontracting Relationships among High-technology Industries in the Northeast Ohio Region", *Environment and Planning A*, 26 (10), 1579-1603.

Crone, M. 2002. "Local Sourcing by Multinational Enterprise Plants: Evidence from the UK Regions and the Implications for Policy", *Environment and Planning C: Government and Policy*, 20 (1): 131 – 149.

Deardorff, A. and S. Djankov. 2000. "Knowledge Transfer under Subcontracting: Evidence from Czech Firms", *World Development*, 28 (10): 1837-1847.

Deavers, K. L. 1997. "Outsourcing: A Corporate Competitiveness Strategy, not a Search for Low Wages", *Journal of Labor Research* 18 (4): 503-519.

Evcimen, G., M. Kaytaz and E.M. Cinar. 1991. "Subcontracting, Growth and Capital Accumulation in Small-Scale Firms in the Textile Industry in Turkey", *Journal of Development Studies*, 28, 130-149.

Gonzalez, M., B. Arrunada and A. Fernandez. 2000. "Causes of Subcontracting: Evidence from Panel Data on Construction Firms", *Journal of Economic Behavior and Organization*, 42(2), 167-87.

Heshmati, A. 2003. "Productivity Growth, Efficiency and Outsourcing in Manufacturing and Service Industries", *Journal of Economic Surveys*, 17: 79-112.

Holmes, J. 1986. "The Organization and Locational Structure of Production Subcontracting", in A.J. Scott and M. Storper (eds.), *Production, Work, and Territory: The Geographical Anatomy of Industrial Capitalism*. Boston; London and Sydney: Allen & Unwin, 80-106.

Imrie, R.F. 1986. "Work Decentralization from Large to Small Firms: A Preliminary Analysis of Subcontracting", *Environment and Planning A*, 18: 949-965.

Kaytaz, M. 1994. "Subcontracting Practice in the Turkish Textile and Metal-working Industries", in F. Senses (ed.), *Recent Industrialization Experience of Turkey in a Global Context*, Westport: Greenwood Press, pp.141-154.

Kelley, M. R. and B. Harrison. 1993. "The Subcontracting Behavior of Single vs.

Multiplant Enterprises in US Manufacturing: Implications for Economic Development", *World Development*, 18(9), 1273-1294.

Kimura, F. 2002. "Subcontracting and the Performance of Small and Medium Firms in Japan", *Small Business Economics*, 18 (1-3): 163-175.

Kumar, N. 1996. *Multinational Enterprises, New Technologies and Export-Oriented Industrialisation in Developing Countries: Trends and Prospects*, INTECH Discussion Paper No.9602, The United Nations University, Maastricht.

Okamuro, H. 2001. "Risk Sharing in the Supplier Relationship: New Evidence from the Japanese Automotive Industry", *Journal of Economic Behavior and Organization*, 45 (4): 361-381.

Ozcan, G.B. 1995. *Small Firms and Local Economic Development*, Aldershot: Avebury Ashgate Publishing Limited.

Piore, M. and C. Sabel. 1984. *The Second Industrial Divide: Possibilities for Prosperity*, New York: Basic Books.

Potter J., B. Moore and R. Spires. 2003. "Foreign Manufacturing Investment in the United Kingdom and the Upgrading of Supplier Practices", *Regional Studies,* (37): 41-60.

Pyke, F. 1992. *Industrial Development Through Small-firm Co-operation*, Geneva: ILO.

Rama, R. and A. Calatrava. 2002. "The Advantages of Clustering: The Case of Spanish Electronics Subcontractors through Spatial Clustering", *International Journal of Technology Management*, 24 (7-8): 764-791.

Rama R., D. Ferguson and A. Melero. 2003. "Subcontracting Networks in Industrial Districts: The Electronics Industries of Madrid", *Regional Studies*, (37): 71- 88.

State Planning Organization. 1989. *Kucuk Sanayi: VI. Bes Yillik Kalkinma Plani Ozel Ihtisas Komisyonu Raporu*, Ankara: SPO.

Taylor, M.J. and N.J. Thrift. 1982. "Industrial Linkage and the Segmented Economy: 1. Some Theoretical Proposals", *Environment and Planning A*, 14: 1601-1613.

UNCTAD. 1994. *Technological Dynamism in Industrial Districts: An Alternative Approach to Industrialization in Developing Countries*, New York: United Nations.

UNIDO. 1974. *Subcontracting for Modernizing Economies*, New York: UN.

Watanabe, S. 1971. "Subcontracting, Industrialisation and Employment Creation", *International Labour Review*, 104, 51-76.

World Bank. 1980. *Turkey, Prospects for Small-Medium Scale Industry Development and Employment Generation*, 3 vols, Washington, DC: World Bank.

Ypeij, A. 1998. "Transferring Risks, Micoproduction, and Subcontracting in the Footwear and Garment Industries of Lima, Peru", *Latin American Perspectives*, 25(2), 84-105.

Yun, M. 1999. "Subcontracting Relations in the Korean Automotive Industry: Risk Sharing and Technological Capability", *International Journal of Industrial Organization*, 17: 81–108.

Table 1. Alternative conceptualizations/different types of subcontracting

	Dualistic approach	Developmental approach	Networks/Clusters
Unit of analysis	Subcontracting relationship: client-subcontractor	Subcontracting relationship: client-subcontractor	A group of interacting firms
Nature of subcontracting	Exploitation/subordination	Dependence/developmental	Equivalance
Direction of action			
client	Active	Active	Active
subcontractor	Passive	Passive	Active
Size of			
client	Large	Large	Small / large
subcontractor	Small	Small	Small / large
Technological level of			
client	High	High	High/medium
subcontractor	Low	Low, but raised by the client	High/medium
Rationale for			
client	Flexibility, risk and cost transfer	Focus on core business	Collective efficiency and flexibility
subcontractor	Only form of existence	Access to markets and technology	Collective efficiency and flexibility
Product/process design	Dictated by the client	Dictated by the client	Client/subcontractor
Impact on the economy	Reproduction of dualistic structure	Modernization	Mutual learning and growth

Table 2. Subcontracting in Turkish manufacturing industries
(average values for the period 1993-2000)

ISIC Code	Industry	Input share (%)		Output share (%)		Employment share in 2000 (%)
		Unweighted	Weighted	Unweighted	Weighted	
31	Food	1.09	0.39	0.30	0.59	15.44
32	Textile	17.10	5.08	7.46	7.40	34.15
33	Wood products	1.95	0.78	0.96	1.14	2.39
34	Paper	5.20	1.83	3.47	2.25	2.98
35	Chemicals	2.30	0.86	1.37	0.97	9.58
36	Pottery, glass, cement	0.91	0.32	1.06	1.89	6.53
37	Basic metal	3.99	1.29	1.97	1.08	5.37
38	Engineering	2.49	0.63	3.28	1.52	22.78
39	Other manufacturing	3.98	3.03	2.72	1.99	0.77
3	*Manufacturing*		*2.60*		*1.66*	100.00
Subcontracting intensive sub-sectors in the textile and engineering industries						
3212	Textile products exc. wearing apparel	8.91	12.39	30.04	5.25	3.25
3222	Wearing apparel, exc. fur and leather	11.70	13.74	22.04	6.22	7.98
3211	Spinning, weaving and finishing	3.22	2.90	19.30	5.67	14.46
3213	Knitting mills	10.52	11.55	7.15	3.26	5.56
3221	Fur and leather products	2.47	3.39	7.67	2.00	0.66
3231	Tanneries and leather finishing	1.02	1.18	7.74	3.88	0.40
3821	Engines and turbines	6.48	1.97	7.70	1.65	0.05
3841	Ship building and repairing	7.64	12.84	5.53	5.12	0.23
3813	Structural metal products	4.17	6.80	3.54	2.79	1.36
3819	Other fabricated metal products	3.09	2.37	4.23	1.09	2.15
3851	Professional and scientific equipment	3.67	5.09	3.34	0.93	0.44

The data cover only those establishments with 10 or more employees.
"Input share" refers to the proportion of subcontracted input in total inputs.
"Output share" refers to the proportion of subcontracted output in total output.
"Employment share" refers to the share of the industry in total manufacturing employment.

Table 3. Descriptive statistics, the textile and engineering industries

Average values for all establishments employing 10 or more workers in the period 1993-2000

Variable label	Decription	Textile industry				Engineering industry			
		No sub.	Subcont.	Client	Two-way contract.	No sub.	Subcont.	Client	Two-way contract.
# obs	Number of observations	7783	5251	6569	7077	11082	1324	6342	7162
SUB-INPUT	Subcontracted input share (%)	0.0	0.0	12.9	16.2	0.0	0.0	8.0	9.6
SUB-OUTPUT	Subcontracted output share (%)	0.0	53.0	0.0	25.1	0.0	22.1	0.0	12.4
SIZE*	Number of employees	35	38	53	70	33	40	47	53
WAGE*	Average wage rate	59.8	58.8	65.1	68.5	73.4	91.3	97.7	105.4
OVER23	Share of 2nd and 3rd shift in total production hours (%)	12.3	13.2	8.5	16.1	3.6	5.6	4.6	7.1
GRFIRM	Annual growth rate of output (log form, x100)	1.1	1.7	5.4	7.8	1.7	1.1	4.5	4.1
NFIRM*	Number of firms in the same sector and province	48	89	161	139	17	21	29	31
PTT	PTT expenditures/sales ratio (%)	0.4	0.5	0.3	0.3	0.4	0.4	0.3	0.3
ADVER	Advertisement expenditures/sales ratio (%)	0.2	0.2	0.3	0.2	0.3	0.3	0.4	0.4
CAPINT*	Depreciation allowances/employees ratio	14.4	11.1	18.5	22.4	15.8	20.0	23.4	26.9
FEMALE	Share of female employees (%)	29.6	37.7	38.7	41.5	10.1	12.2	12.3	11.7
ADMIN	Share of administrative personnel (%)	12.5	9.6	16.4	14.0	16.4	18.6	20.7	21.6
SKILLED	Share of skilled employees (%)	14.3	12.9	14.4	13.4	19.9	19.2	21.7	21.1

* geometric average

Clients receive inputs from subcontractors. **Subcontractors** produce output subcontracted by other firms.

Two-way contractors receive offers from clients and outsource some inputs to subcontractors.

No subcontacting includes those firms that are not involved in any form of subcontracting relationship.

WAGE, CAPINT, GRFIRM and GRIND variables are measured at constant 1994 prices.

Table 4. Determinants of subcontracting in Turkish textile and engineering industries

Explanatory variables	Textile industry				Engineering industry			
	Subcontract receiving		Subcontract offering		Subcontract receiving		Subcontract offering	
	Coeff	Std.Err.	Coeff	Std.Err.	Coeff	Std.Err.	Coeff	Std.Err.
SIZE	-0.025	0.005 **	0.036	0.002 **	0.008	0.008	0.009	0.002 **
WAGE	-0.007	0.009	0.001	0.004	0.058	0.010 **	0.021	0.003 **
OVER23	0.069	0.019 **	-0.040	0.009 **	0.041	0.036	0.011	0.012
GRFIRM	-0.039	0.005 **	0.001	0.002	-0.008	0.007	0.004	0.002 *
NFIRM	0.014	0.004 **	0.033	0.001 **	0.021	0.005 **	0.018	0.002 **
PTT	1.968	0.386 **	0.205	0.183	-0.170	0.475	-0.289	0.175
ADVER	0.167	0.338	0.079	0.139	0.537	0.390	0.387	0.113 **
CAPINT	-0.020	0.003 **	0.004	0.001 **	0.003	0.004	0.003	0.001 **
FEMALE	0.109	0.019 **	0.085	0.008 **	0.054	0.042	0.026	0.012 *
ADMIN	-0.428	0.040 **	0.113	0.016 **	-0.061	0.042	0.048	0.012 **
SKILLED	-0.059	0.025 *	-0.008	0.011	-0.093	0.031 **	0.022	0.009 **
TIME	-0.002	0.002	-0.002	0.001 *	-0.007	0.002 **	-0.003	0.001 **
Constant	3.424	3.544	2.858	1.514	13.892	4.480 **	6.277	1.293 **
σ_u	0.573	0.009 **	0.170	0.003 **	0.340	0.009 **	0.120	0.002 **
σ_e	0.277	0.003 **	0.133	0.001 **	0.239	0.004 **	0.096	0.001 **
$\rho \quad (\sigma_u^2/(\sigma_u^2+\sigma_e^2))$	0.811	0.005	0.619	0.009	0.670	0.013	0.611	0.010
Wald test, $\chi^2(12)$	410.8		972.5		89.0		365.9	
Log likelihood	-10584.3		-880.4		-3948.3		545.3	
# firms	5120		5120		3759		3759	
# observations	19851		19851		15651		15651	
# obs, subcontracting	9322		9322		2435		2435	
# obs, no subcontracting	10529		10529		13216		13216	

Note: ** (*) means statistically significantly different from zero at the 1% (5%) level, two-tailed test.

Figure 1. Distribution of textile and engineering firms and subcontracting relationships in Turkey
(Provinces' share in total number of firms and value of subcontracting transactions)